Subchapter H
Ground-Water Protection Design and Operation

§330.200. Design Criteria.

(a) New MSWLF units and lateral expansions shall be constructed in accordance with one of the two following provisions approved by the executive director:

(1) a design that ensures that the concentration values listed in Table 1 of this section will not be exceeded in the uppermost aquifer at the relevant point of compliance, as specified by the executive director under subsection (d) of this section; or

(2) a composite liner, as defined in subsection (b) of this section, and a leachate collection system that is designed and constructed to maintain less than a 30-cm depth of leachate over the liner.

(b) For purposes of this section, "composite liner" means a system consisting of two components; the upper component must consist of a minimum 30-mil flexible membrane liner (FML) and the lower component must consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ cm/sec. FML components consisting of High Density Polyethylene (HDPE) shall be at least 60-mil thick. The FML component must be installed in direct and uniform contact with the compacted soil component.

(c) When approving a design that complies with subsection (a)(1) of this section, the executive director may consider at least the following factors:

(1) the hydrogeologic characteristics of the facility and surrounding land;

(2) the climatic factors of the area; and

(3) the volume and physical and chemical characteristics of the leachate.

(d) For purposes of this section, the relevant point of compliance is defined in §330.2 of this title (relating to Definitions). In determining the relevant point of compliance, the executive director may consider at least the following factors:

(1) the hydrogeologic characteristics of the facility and surrounding land;

(2) the volume and physical and chemical characteristics of the leachate;

(3) the quantity, quality, and detection of flow of ground water;

(4) the proximity and withdrawal rate of the ground-water users;

(5) the availability of alternative drinking water supplies;

(6) the existing quality of the ground water,including other sources of contamination and their cumulative impacts on the ground water and whether ground water is currently used or reasonably expected to be used for drinking water;

(7) public health, safety, and welfare effects; and

(8) practicable capability of the owner or operator.

TABLE 1

Chemical	MCL (mg/l)
Arsenic	0.05
Barium	1.0
Benzene	0.005
Cadmium	0.01
Carbon tetrachloride	0.005
Chromium (hexavalent)	0.05
2,4-Dichlorophenoxy acetic acid	0.1
1,4-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
Endrin	0.0002
Fluoride	4
Lindane	0.004
Lead	0.05
Mercury	0.002
Methoxychlor	0.1
Nitrate	10
Selenium	0.01
Silver	0.05
Toxaphene	0.005
1,1,1-Trichloroethane	0.2
Trichloroethylene	0.005
2,4,5-Trichlorophenoxy acetic acid	0.01
Vinyl chloride	0.002

(e) Type IV landfills authorized to dispose of brush and demolition materials only shall meet one of the following ground-water protection requirements listed in paragraph (1) or (2) and in addition all Type IV sites shall have Soils and Liner Quality Control Plan as described in paragraph (3) of this subsection.

(1) There shall exist at least four feet of in-situ soil between the deposited waste and ground water. This in-situ soil shall constitute an in-situ liner and shall meet all the physical properties for a constructed liner as detailed in §330.205(c)(6) of this title (relating to Soil and Liner Quality Control

Plan). In-situ liners shall not exhibit primary or secondary physical features such as jointing, fractures, bedding planes, solution cavities, root holes, desiccation shrinkage cracks etc. that have a coefficient of permeability greater than $1x10^{-7}$ cm/sec.

(2) There shall be at least a three-foot thick compacted clay liner between the deposited waste and ground water. The constructed liner shall meet all the criteria detailed in §330.205 of this title (relating to Soil and Liner Quality Control Plan) and shall at a minimum have one foot of protective cover overlying the compacted liner after all quality control testing and final thickness determinations are complete.

(3) All Type IV landfill permits shall include a Soils and Liner Quality Control Plan (SLQCP) as required by §330.205 of this title (relating to Soil and Liner Quality Control Plan) and should follow the latest technical guidelines of the executive director. The owner or operator shall submit a Soils and Liner Evaluation Reports (SLERs) in accordance with §330.206 of this title (relating to Soils and Liner Evaluation Report (SLER) and Flexible Membrane Liner Evaluation Report (FMLER).

§330.201. Leachate Collection System.

Leachate-collection and associated leachate-removal systems shall be:

(1) constructed of materials that are chemically resistant to the leachate expected to be generated;

(2) of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill; and

(3) designed and operated to function through the scheduled closure and post-closure period of the landfill.

§330.202. Alternate Design.

Alternate liner designs may be authorized by the executive director if the owner or operator provides a demonstration by computerized design modeling (for example, the "Help" and "Multi-Media" models) that shows that the maximum contaminant levels detailed in §330.200 of this title (relating to Design Criteria), Table 1 will not be exceeded at the point of compliance. At the discretion of the executive director, a field demonstration may be required to prove the practicality and performance capabilities of an alternative design.

§330.203. Special Conditions (Liner Design Constraints).

(a) The owner or operator of a Type I landfill shall demonstrate that the liner system will not undergo uplift from hydrostatic forces during its construction by using one or more of the following methods:

(1) providing calculations satisfactory to the executive director that the weight of the liner systems, including any ballast, is sufficient to offset by a factor of 1.2 any otherwise unbalanced upward or inward hydrostatic forces on the liner; or

(2) incorporating an active or passive dewatering system in the design to reduce upward or inward hydrostatic forces on the liner by a factor of 1.2 and by providing calculations satisfactory to the executive director that the dewatering system will perform to adequately reduce those forces; or

(3) providing evidence satisfactory to the executive director that the soil surrounding the landfill is so poorly permeable that ground water can not move sufficiently to exert force that would damage the liner; or

(4) providing evidence that the seasonal high water table is below the deepest planned excavation.

(b) The owner or operator shall ensure that the liner is stable during the filling and operation of the landfill through a suitable combination of dewatering and/or ballast, if determined to be required in subsection (a)(1)-(3) of this section. These methods shall not be used without prior approval of the executive director.

(c) Any required leachate collection system shall be designed to handle both the leachate generated and the groundwater inflow from materials beneath and lateral to the liner system. The maximum volume of groundwater inflow shall be calculated based on determination of the permeability and potentiometric conditions of the liner system and of the materials surrounding the liner system.

(d) Prior to excavating any unit below the seasonal high water table, the owner or operator shall perform a preliminary foundation evaluation satisfactory to the executive director. The foundation evaluation shall consider stability, settlement, and constructability.

(e) The Soil and Liner Quality Control Plan (SLQCP) as required in §330.205(a)(3)(B) of this title (relating to Soils and Liner Quality Control Plan) shall include the following information for landfills to which subsection (a)(1)-(3) of this section are applicable:

(1) the methods and tests to be used to verify that the liner will not undergo uplift during construction and until ballast placement, if required, is complete; and

(2) the measures and tests that will be used to verify that any required ballast meets the criteria established, including but not limited to inspections, compaction, weight and density of material, thickness, and top elevations.

(f) If ballast is used, a Ballast Evaluation Report (BER) in a format specified by the executive director shall be submitted in triplicate to the Municipal Solid Waste Division for review and approval. Verbal approval may be obtained from the executive director, which will be followed by written confirmation. If no response is provided within 14 days of the date on which the BER document is date-stamped by the Municipal Solid Waste Division, the BER may be considered approved. If the

executive director determines that the BER is incomplete or that the test data provided are insufficient to support the evaluation conclusions, additional test data or other information may be required. The BER shall include:

(1) verification that the liner did not undergo uplift during construction, using the method identified in the SLQCP;

(2) certification that ballast met the criteria established in this section and in the SLQCP; and

(3) signature and seal of the registered professional engineer performing the evaluation and signature of the site operator or his authorized representative.

(g) Any dewatering systems used to ensure liner stability during construction and filling shall be operated until the executive director determines that such systems are no longer required.

(h) At the discretion of the executive director, owners or operators of Type IV landfill excavations that extend below the seasonal high water table may be required to meet one or more provisions in this subsection.

(i) The executive director may determine on a site-specific basis that waste can be used as ballast. If so, the site operating plan for the landfill shall contain the following requirements.

(1) The first five feet or the total thickness of the ballast, whichever is less, placed on the liner system shall be free of brush and large bulky items, which would damage the underlying parts of the liner system or which cannot be compacted to the required density.

(2) If waste is used for ballast, a wheeled trash compactor having a minimum weight of 40,000 pounds, or equivalent equipment, shall be properly utilized to reach a compaction density of at least 1,000 pounds per cubic yard. For purposes of determining the required ballast thickness, a density of compacted waste of 1,000 pounds per cubic yard shall be used. The weight of the liner system, including any ballast, must be sufficient to offset any unbalanced upward or inward hydrostatic forces on the liner by a factor of 1.5 when waste is used for ballast.

(3) The SLQCP shall also include the method(s) to be used to verify that compaction of waste used for ballast is to a density of not less than 1,000 pounds per cubic yard. If a trash compactor having a minimum weight of 40,000 pounds is used, no compaction density verification will be required.

(4) If waste is used for ballast, the BER shall also include verification that a trash compactor having a minimum weight of 40,000 pounds was used or, if not, that compaction was at least 1,000 pounds per cubic yard.

(j) The seasonal high water table shall be adjusted upward, if necessary, as additional data become available after a permit is issued.

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§330.204. Geological Faults.

New MSWLF units and lateral expansions shall not be located within 200 feet of a fault that has had displacement in Holocene time (approximately 11,000 years) unless the owner/operator demonstrates to the executive director that an alternative setback distance of less than 200 feet will prevent damage to the structural integrity of the MSWLF unit and will be protective of human health and the environment. All applications submitted for the operation of a MSWLF facility shall include a preliminary fault investigation report, as required in §330.303 of this title (relating to Fault Areas), prepared by a geologist or an engineer experienced in fault determinations. The report shall include all results of direct site observations and a literature review of historical seismic activity and faulting in the area. If a facility is to be located within areas which may be subject to differential subsidence or active geological faulting, the application must include detailed fault studies. When an active fault is known to exist within one-half mile of the site, the site shall be investigated for both previously identified and unknown faults. Areas experiencing withdrawal of crude oil, natural gas, sulfur, etc., or significant amounts of ground water shall be investigated in detail for the possibility of subsidence-faulting/growth-faulting which could adversely affect the integrity of landfill liners. The studies shall establish the fault-displaced limits of the zones of influence of all active faulted areas within the site vicinity. Unless the applicant can provide substantial evidence that the zone of influence will not affect the site, no solid waste disposal activity shall be undertaken within a zone of influence of active geological faulting or differential subsidence. The studies shall include information or data on the items in paragraphs (1)-(11) of this subsection, as applicable:

(1) structural damage to constructed facilities (roadways, railways, and buildings);

(2) scarps in natural ground;

(3) presence of surface depressions (sag ponds and ponded water);

(4) lineations noted on aerial maps and topographic sheets;

(5) structural control of natural streams;

(6) vegetation changes;

(7) electrical spontaneous potential and resistivity logs (correlation of subsurface strata to check for stratigraphic offsets);

(8) earth electrical resistivity surveys (indications of anomalies which may represent fault planes);

(9) open trench excavations (visual examinations to detect changes in subsoil texturing and/or weathering indicating stratigraphic offsets);

(10) changes in elevations of established benchmarks; and

(11) references to published geological literature pertaining to area conditions.

§330.205. Soils and Liner Quality Control Plan.

(a) A landfill must have an approved Soils and Liner Quality Control Plan (SLQCP) prepared under the direction of a registered professional engineer, and it shall be the basis for the type and rate of quality control testing performance and reported in the Soil and Liner Evaluation Report (SLER) as required in §330.206 of this title (relating to Soils and Liner Evaluation Report (SLER) and Flexible Membrane Liner Evaluation Report (FMLER). The SLQCP must be included in the Site Development Plan to provide operating personnel adequate procedural guidance for assuring continuous compliance with ground-water protection requirements. The plan shall specify construction methods employing good engineering practices for compaction of clay soils to form a liner. Unless alternate construction procedures are approved in writing by the executive director, all constructed liners shall be keyed into an underlying formation of sufficient strength to ensure stability of the constructed lining. The SLQCP shall address the installation and testing of a FML liner, if used. Proposed dewatering plans shall be included. The SLQCP shall include the following information.

(1) Constructed liner details, where applicable shall be depicted on cross-sections of a typical trench showing the slope, widths, and thicknesses for compaction lifts. The amount of compaction shall be expressed as a percentage of a predetermined laboratory density.

(2) Soil and liner quality-control testing procedures, to include sampling frequency, shall be included in the SLQCP. All field sampling and testing, both during construction and after completion, shall be performed by a person acting in compliance with the provisions of the Texas Engineering Practice Act and other state laws and regulations. The professional of record who signs the Soils and Liner Evaluation Report (SLER) or his representative should be on site during all liner construction. Quality control of construction and quality assurance of sampling and testing procedures should follow the latest technical guidelines of the executive director.

(b) An SLQCP shall also:

(1) describe and illustrate, for operating personnel, all necessary procedures for assuring continuous compliance with this subsection;

(2) provide guidance needed for testing and reporting evaluation procedures to the professional who will prepare the SLERs for the site;

(3) specify materials, equipment, and construction methods for the compaction of clay soils to form impermeable liners for the conditions described in subparagraphs (A) and (B) of this paragraph. The SLQCP shall adhere to the testing frequencies and procedures as specified.

(A) Details for the overexcavation and recompaction of the in-situ soils, or the compaction of soils from a borrow source, shall be depicted on cross-sections of a typical trench showing the slope, widths, and thicknesses for compaction lifts.

(B) Procedures to be followed when excavations, trenches, or disposal areas extend into or have the potential to extend into the ground water shall be in accordance with the provisions provided in §330.203 of this title (relating to Special Conditions (Liner Design Constraints); and

(4) describe installation methods and quality control testing and reporting for any FML that may be required or authorized by the executive director as a part of a composite liner.

(c) Soil liner quality control testing frequencies and procedures shall be in accordance with the executive director's most recent guidelines and the following.

(1) All field sampling and testing, both during construction and after completion of the lining, shall be performed by a qualified professional experienced in geotechnical engineering and/or engineering geology, or under his direct supervision.

(2) All liners should have continuous on-site inspection during construction by the professional of record or his designated representative.

(3) The amount of compaction of clay liners shall be expressed as a percentage of a maximum dry density based on a compaction test specified by a registered professional engineer. The compaction of the clay liner shall have been proven by soils laboratory testing to provide a coefficient of permeability of $1x10^{-7}$ cm/sec or less.

(4) The SLQCP shall define the frequency of testing for each of the test procedures listed in subparagraphs (A)-(F) of this paragraph. These frequencies shall be expressed in numbers of tests per specific area of liner per lift or specific thickness of liner, unless an alternate frequency is approved by the executive director:

(A) coefficient of permeability;

(B) Sieve analysis;

(C) Atterberg limits;

(D) density;

(E) moisture content;

(F) thickness verification.

(5) Unless otherwise approved by the executive director, all soil tests performed on any in-situ or constructed soil liners shall be in accordance with the standards in subparagraphs (A)-(E) of this paragraph.

(A) laboratory permeability tests. Permeability tests shall be run using tap water or .05N solution of CaSO4 and not distilled water. All test data must be submitted on permeability tests regardless of test method used. At a minimum, the calculations of the last data set reported for each sample and the resultant coefficient of permeability shall be reported as supporting data. Tests shall be either constant head with back pressure (Appendix VII of Corps of Engineers Manual, EM 1110-2-1906; ASTM D5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter,") or falling head (Appendix VII of Corps of Engineers Manual, EM1110-2-1906);

(B) Sieve analysis +1, 200, -200 sieves; (ASTM D422 or ASTM D1140, as applicable);

(C) Atterberg limits (ASTM D4318);

(D) moisture-density relations (ASTM D698 or any executive-director-approved modified test whose compactive effort matches the on site construction equipment);

(E) moisture content (ASTM D2216).

(6) All soils used as constructed liners must have the following minimum values verified by testing in a soils laboratory: Plasticity index-Equal to or Greater than 15; Liquid limit -Equal to or Greater than 30; Percent passing 200 mesh sieve (-200) Equal to or Greater than 30%; Percent passing 1 inch screen-100%; Coefficient of permeability less than or equal to 1×10^{-7} cm/sec.

(7) Permeability tests for proving the suitability of soils to be used in constructing clay liners shall be performed in the laboratory using the procedures and guidance of paragraph (5)(A) of this subsection. Field quality control must be provided by field density tests based on predetermined moisture-density compaction curves, Atterberg limits, and laboratory permeabilities of undisturbed field samples of compacted liner soils, unless an alternate plan is approved by the executive director.

(8) Field permeability testing of in-situ soils or constructed soil liners shall be in accordance with ASTM D 5093 for those soil liners which are in the floor of the excavation and a variation of the Boutwell STEI field permeability test approved by the executive director for the sidewalls, or in accordance with guidance furnished by the executive director.

(9) All quality control testing of soil liners shall be performed during the construction of the liner. In no instance shall any quality control field or laboratory testing be undertaken after completion of liner construction, except for that testing which is required of the final constructed lift, confirmation of liner thickness, or cover material thickness.

(10) All soil testing and evaluation of either in-situ soil or constructed soil liners shall be complete prior to installing the LCS or, if no LCS is required, prior to adding the one foot of protective cover on the area under evaluation.

(d) Soil and liner density shall be expressed as a percentage of the maximum dry density and at the corresponding optimum moisture content specified as appropriate by a registered professional engineer experienced in geotechnical engineering. These soils so compacted must upon testing either in the laboratory or as a test pad in the field demonstrate a coefficient of permeability no greater than $1x10^{-7}$ cm/sec.

(e) Unless alternate construction procedures have prior written approval by the executive director, all constructed soil liners shall be keyed into an underlying formation of sufficient strength to ensure stability of the constructed lining.

(f) Each SLER shall be prepared in accordance with the approved SLQCP. Any deviation from an approved SLQCP must have prior written approval from the executive director.

(g) Soil liners shall not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller. All soil liners shall be compacted with a pad-footed or prong-footed roller only. The maximum clod size of the compacted liner soils shall be approximately one inch in diameter. In all cases soil clods shall be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory and to destroy any macrostructure evidenced after the compaction of the clods under density-controlled conditions.

(h) The liner soil material shall contain no rocks or stones larger than one inch in diameter or that total more than 10% by weight. Rock content shall not be a detriment to the integrity of the overlying geomembrane.

§330.206. Soils and Liner Evaluation Report (SLER) and Flexible Membrane Liner Evaluation Report (FMLER).

(a) Prior to the disposal of solid waste in any trench, or on any area, excavation, or unprotected surface, a SLER and a FMLER shall be submitted to the executive director for review and approval. If the approved design does not require a synthetic liner, a FMLER is not required.

(b) Each SLER and FMLER shall be submitted in triplicate (including all attachments) to the Municipal Solid Waste Division and shall be prepared in accordance with the methods and procedures contained in the approved SLQCP. The evaluated disposal trench, excavation, or area should not be used for the receipt of solid waste until approval is received from the executive director. The executive director will make every effort to review and respond to the permittee either verbally or in writing within 14 days from the date on which the SLER document is date-stamped by the Municipal Solid Waste Division. Verbal approval may be obtained from the executive director, which will be followed by written concurrence. If no response, either written or verbal, is provided within 14 days, the SLER or FMLER shall be considered approved.

(c) The executive director shall be provided sufficient documentation to assure that the potential for contamination of waters in the state is minimized. If the executive director determines that the SLER is incomplete or that the test data provided are insufficient to support the evaluation conclusions, additional test data or other information may be required, and use of the trench or disposal area will not be allowed until such additional data are received, reviewed, and approved. Each SLER must be signed and, where applicable, sealed by the individual performing the evaluation and counter-signed by the site operator or his authorized representative.

(d) Markers shall be placed on site at the MSWLF facility so that all disposal areas for which a SLER has been submitted and approved by the executive director are readily determinable. Such markers are to provide site workers immediate knowledge at all times of the extent of approved disposal areas. These markers shall be located so that they are not destroyed during operations and shall be in accordance with §330.55(b)(10) of this title (relating to site development plan).

(e) The surface of a constructed soil liner should be covered with a layer of solid waste within a period of six months to mitigate the effects of surface erosion and rutting due to traffic. Liner surfaces not covered with waste within six months shall be checked by the SLER evaluator, who shall then submit a letter report on his findings to the executive director. Any required repairs shall be performed promptly. A new SLER shall be submitted on the new construction for all liners that need repair due to damage.

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